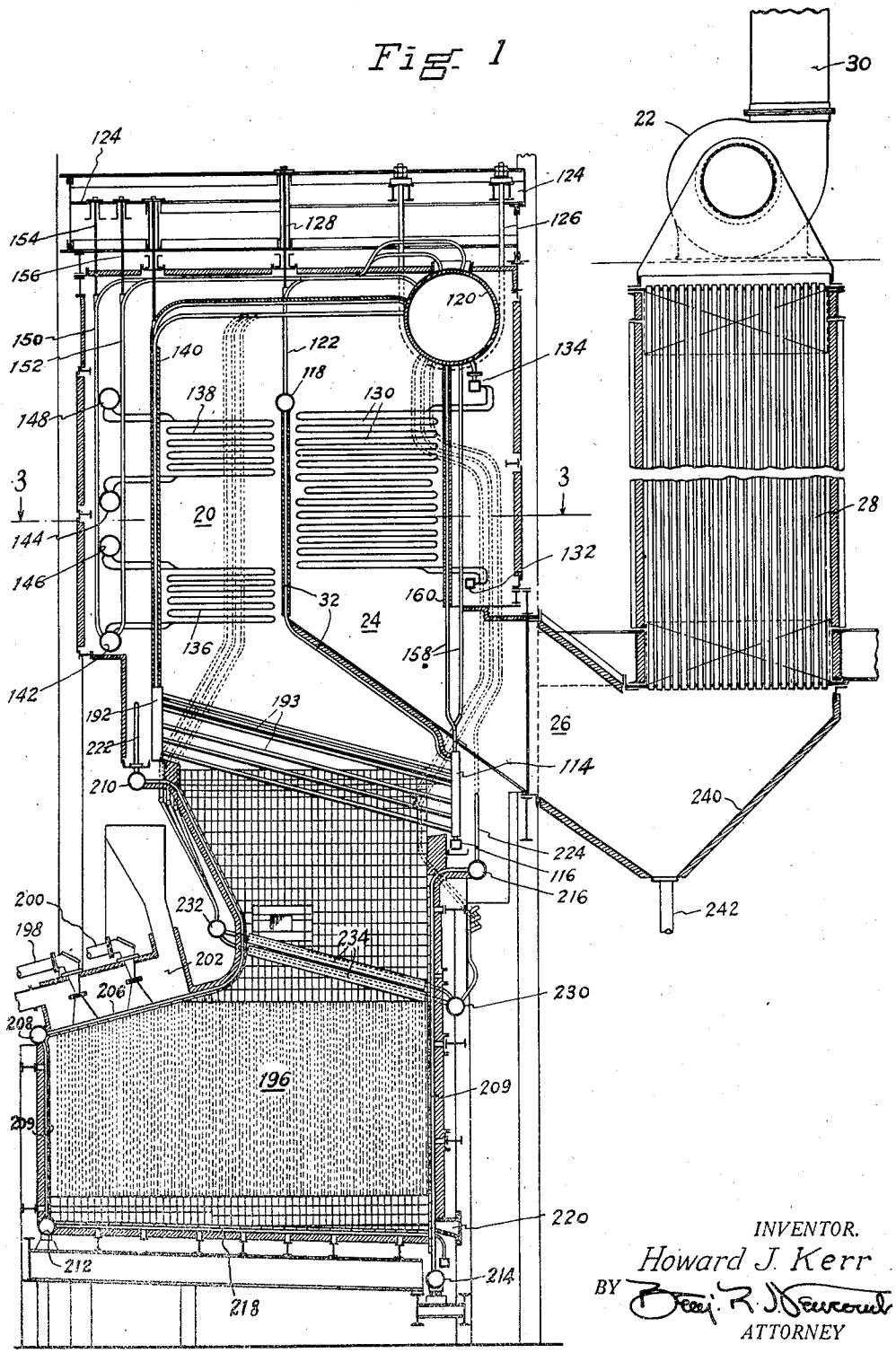
Oct. 25, 1938. H. J. KERR 2,133,992

WALL CONSTRUCTION

Filed Aug. 3, 1935 4 Sheets-Sheet 1

Fig. 1



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WALL CONSTRUCTION

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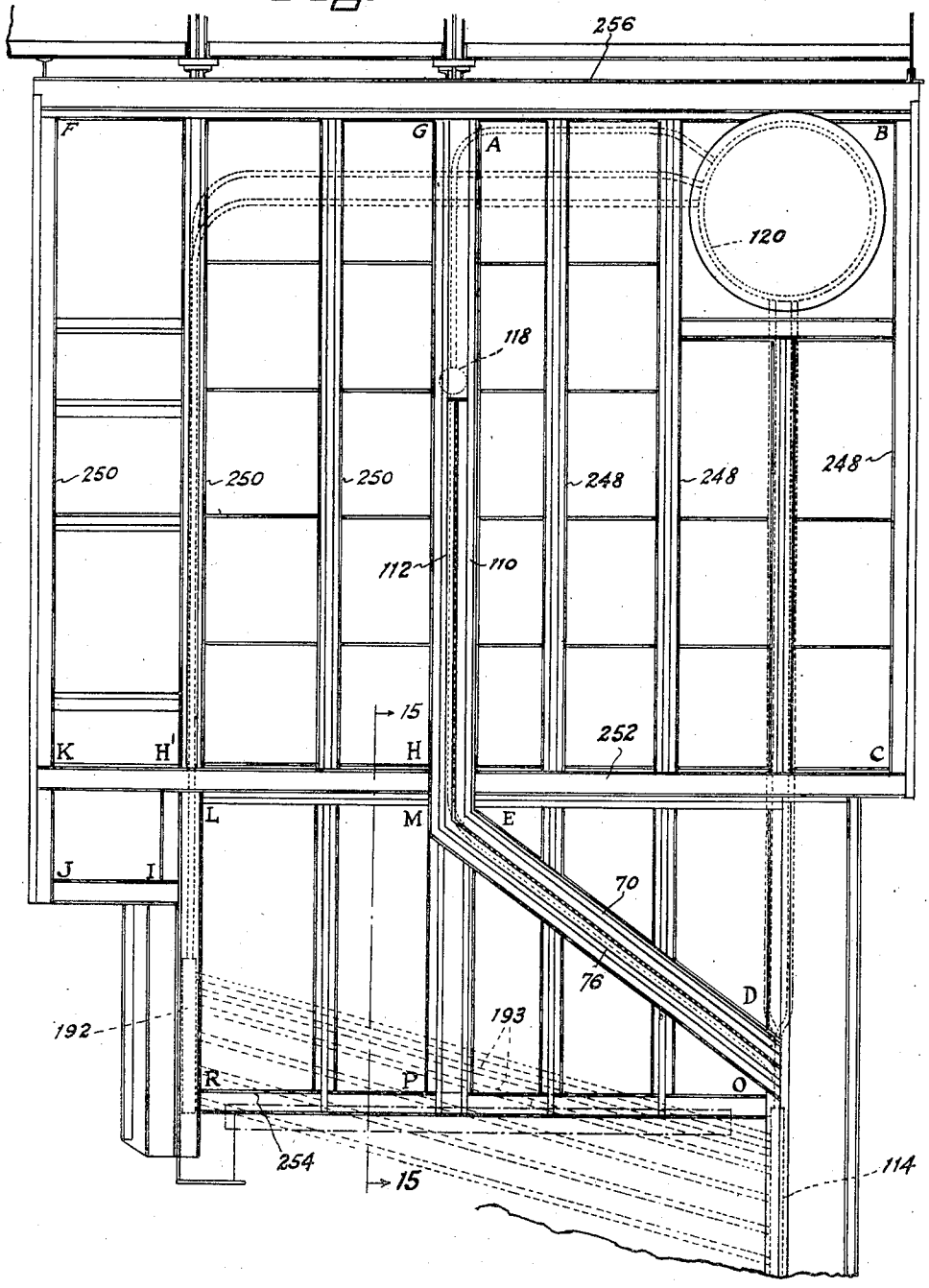
Fig. 2



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WALL CONSTRUCTION

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Fig. 3

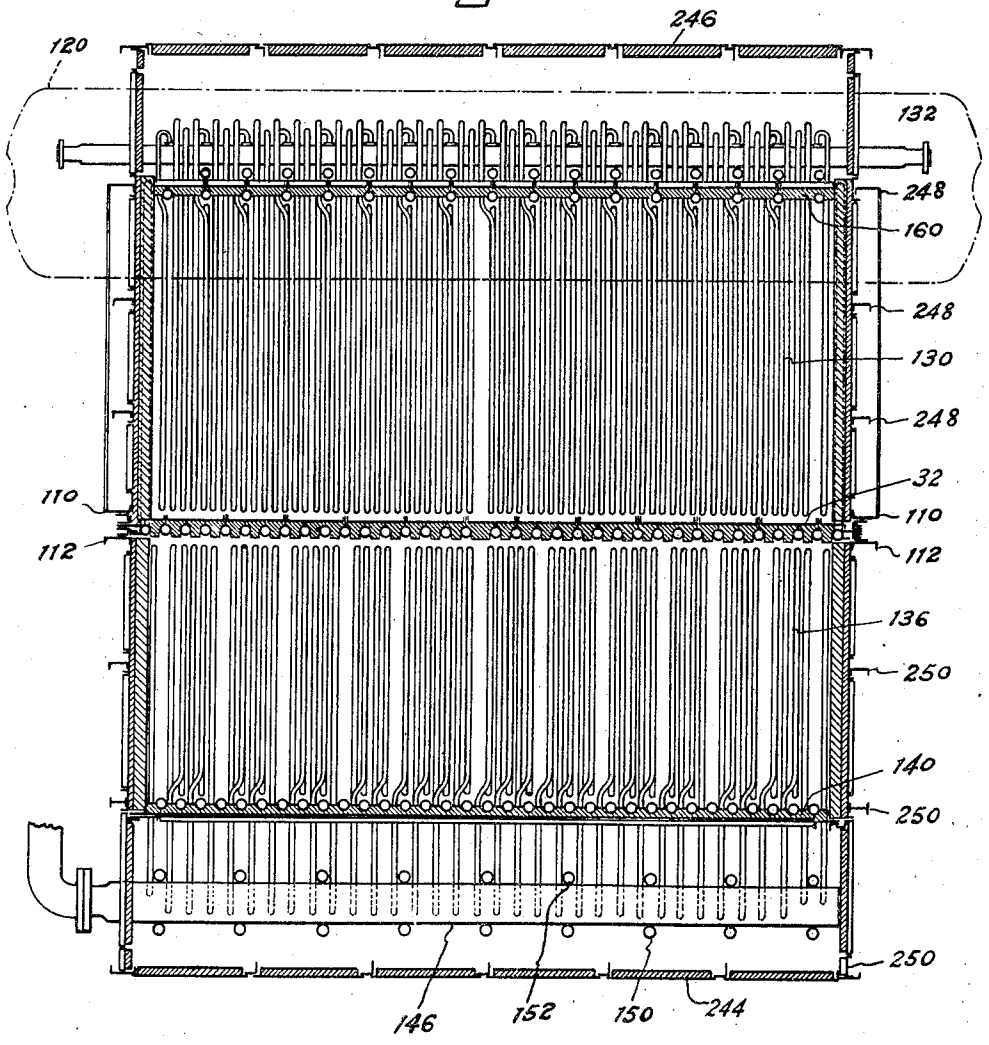

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Fig. 5

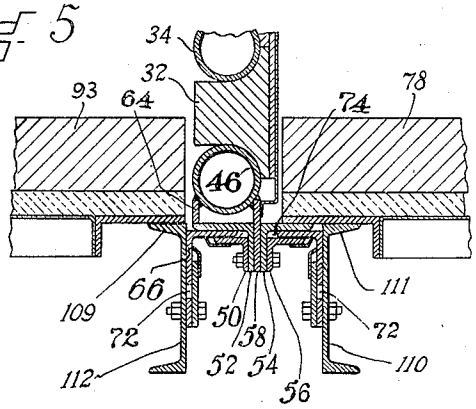


Fig. 4

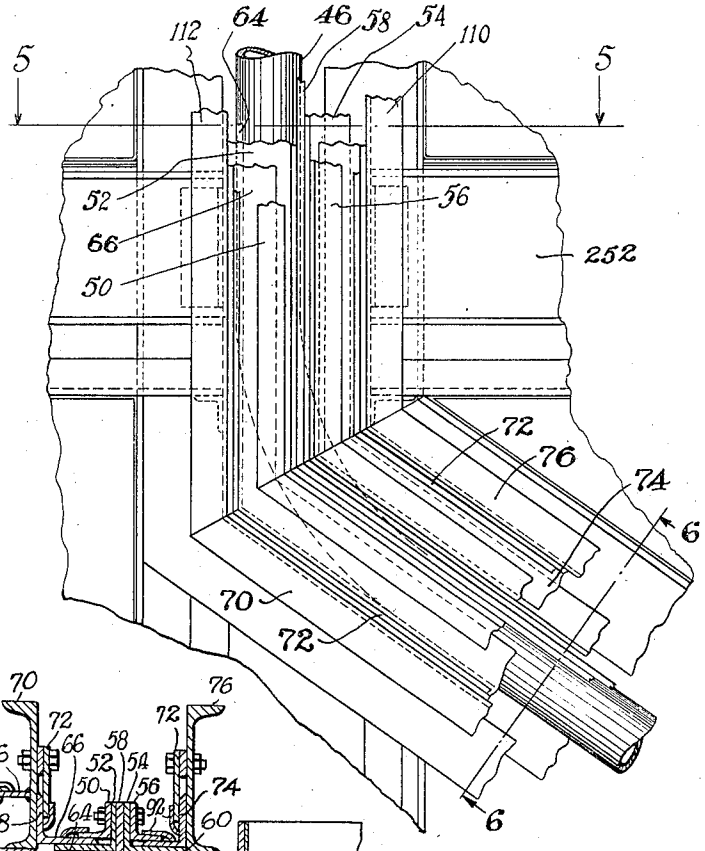
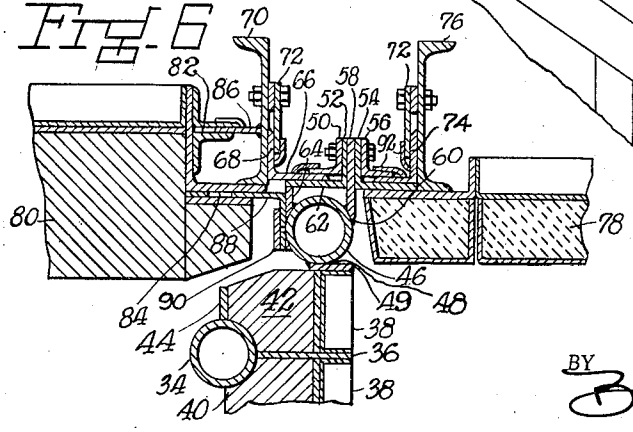


Fig. 6



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Patented Oct. 25, 1938 2,133,992

UNITED STATES PATENT OFFICE

2,133,992

WALL CONSTRUCTION

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Application August 3, 1935, Serial No. 34,537

20 Claims. (Cl. 122—235)

This invention is concerned with wall constructions.

In a specific form it relates to improvements in apparatus through which fluids or gases pass at different pressures and temperatures. It is exemplified herein as a steam boiler heated by furnace gases at pressures differing to an unusual degree in adjoining gas passes.

The invention will be readily understood from the description of the steam boiler shown in the accompanying drawings, in which:

Fig. 1 is a vertical sectional view of a water tube steam boiler associated with a slag tap furnace.

Fig. 2 is a partial side elevation of the installation of Fig. 1, showing the exterior of the boiler casing and the position of the fluid cooled partition which extends through and completely separates two parts of the casing.

Fig. 3 is a view in the nature of a section taken on a horizontal plane at a level below that of the boiler drum.

Fig. 4 is a partial view in the nature of an elevation, showing the wall or casing construction at the juncture of the vertical and inclined parts of the fluid cooled partition.

Fig. 5 is a section on the line 5—5 of Fig. 4 showing the structure associating the vertical part of the fluid cooled partition with the high temperature casing on one side and the low temperature casing on the other.

Fig. 6 is a section similar to that of Fig. 5, but taken on the section line 6—6 of Fig. 4, and showing the structure along the inclined part of the fluid cooled partition.

Referring to Fig. 1 of the drawings, there is shown a furnace from which hot gases pass across steam generating tubes and then through an up-pass 20. Under the effect of the induced draft fan 22 the gases are next drawn through the down-pass 24 and the outlet 26 to the air heater 28. They are drawn through the fan and blown through the exhaust conduit 30 to a stack.

The gas pressures within the furnace and the gas passes are sub-atmospheric throughout, and the pressure at the outlet 26 is much less than the pressure at the bottom of the up-pass. It is also to be appreciated that these pressure relationships must be maintained if a uniformly high combustion rate is to be effected in the furnace and a uniformly high gas velocity secured in the gas passes. Any substantial gas leaks from the up-pass directly into the outlet or into the lower part of the down-pass would quickly impair the effectiveness of the apparatus because of the destructive action of the high temperature gases. Without said destructive action, such leakage would result in efficiency losses.

The gases in the up-pass have temperatures higher than those in the down-pass, and hundreds of degrees higher than the water, or water and steam mixture in the circulating system of the boiler. Therefore, any physical parts of the apparatus which are separately affected by these different temperatures must be permitted to have relative movement. This invention involves parts which cooperate to prevent the above described destructive action, but are so situated that they tend to separately approach the three different orders of temperatures mentioned. One of these parts is the casing section forming walls of the up-pass 20, and a second is the casing section forming walls of the down-pass 24. The third part is the fluid cooled partition 32 which separates the casing sections and is movable relative to them.

The manner in which the casing sections are related to the partition 32 is well illustrated in Fig. 6, of the drawings. This figure indicates a section through the inclined portion of the partition wall which is protected on its up-pass side by cooling tubes 34 having fins 36 welded thereto. These fins afford supports for the panels 38 and the interposed refractory 40. At the edges of the partition the refractory 42 is additionally held in position and protected by a welded fin 44 preferably disposed at a right angle to the fin 36.

The seal tube 46 is preferably made rigid with the partition by a weld 48 secured to the panel construction or to a plate 49 rigid therewith. Baffle mix may be placed between this plate and the tube, and in all similar sealing positions. This tube also carries an expansion joint and gas seal structure including the angles 50, 52, 54 and 56 which are preferably rigid with a bar or fin 58 welded to the tube at 60. The angle 56 has one flange 62 welded to a fillet 64 which is in turn welded to the tube 46 and positioned parallel to the fin 58. Baffle mix may be positioned between the tube 46 and the flange 62 as heat resisting material also acting as a filler.

The manner in which the casing sections are related to the partition wall 32 is illustrated in Fig. 5 of the drawings. The wall of one casing is indicated at 78 and the wall 93 is a part of the other casing section. It will be understood that one of these walls is on the up-pass side of the partition or common wall 32, and the other wall is on the down-pass side of that common wall. The wall 32, cooled and supported by the tubes

34 extends between the spaced ends of the walls 78 and 93 as shown, and there is a separate gas seal and expansion joint structure between each of the walls 78 and 93, and the wall 32. By means of this arrangement of parts, the wall 78 may move relative to the wall 32 independently of similar movement which the wall 93 may have relative to the wall 32. These structures also maintain a separate fluid seal between the walls 78 and 32, on the one hand, and an independently operating fluid seal between the walls 32 and 93, on the other hand.

Fig. 5 also shows the upright buckstays 110 and 112. These members may be considered as fixed, with the walls 78 and 93 so arranged that they bear against the flanges 109 and 111, of the buckstays.

One of the tubes 34 at the edge of the wall 32 has plates or fins 36 and 38, welded thereto. The fin 38 extends into the space between the buckstays 110 and 112 and has secured thereto the oppositely extending angles 40, 42, 44, and 46. The inner flanges of these angles are spaced so as to form guideways 50 and 52 for corresponding flanges of the floating angles 54 and 56. The other flanges of the latter are arranged to be movable in guideways 60 and 62 which are formed by the buckstays and plates 64 and 66, which are fixed in spaced relation to the buckstays, as shown. With this arrangement of structures the wall 32 may so expand that it moves transversely of the buckstays. When such movement takes place the parallel flanges of the floating angles 54 and 56 move in the guideways 60 and 62, and separate fluid seals between the wall 32 and the adjacent walls 78 and 93 are maintained. Similarly there may be relative motion between either of the walls 78 and 93 and the wall 32. When any such movement takes place there is movement of one of the flanges of one of the floating angles 54 and 56 in one of the guideways 50 and 52.

The fluid seals provided on opposite sides of the fins 38 are made more effective by the presence of sealing strips or clips 68 and 70 which are secured to the floating angles in the position shown. Asbestos packing or some equivalent material may be placed under these strips to further make the fluid seals more effective.

One flange of the angle 50 is parallel to the flange 62 and spaced therefrom to provide a passage in which the flange 66 of the floating angle may slide with a reasonably close fit to prevent excessive leakage of air into the furnace. The other flange 68 of the floating angle is guided between an inclined buckstay 70 and a bar 72 fixed thereto. On the other side of the fin 58 there is a similar arrangement of elements cooperating with the floating angle 74.

The buckstay 76 preferably supports a wall 78 which is a part of the casing section for the down-pass 24, and the wall 80, a part of the up-pass casing section, which is thicker than the wall 78 because it is exposed to furnace gases at higher temperatures. The latter wall is guided by the buckstay 70, and an expansion joint gas seal is provided between the buckstay and the wall. As shown, this seal consists of wall members forming channels 82 and 84 which slidably receive flanges 86 and 88 preferably secured, respectively, to the buckstay 70 and the seal tube 46. The flange 88 is a part of a floating angle the other flange of which slides in a guideway formed by the tube 46 and a bar 90 spaced from the tube but welded to it along one edge.

Sealing strips or clips 92 secured to the floating angles 66 and 74 complete the gas sealing structure. Asbestos packing may be placed under these strips and at all similar sealing positions.

It will be noted that the parts rigid with the partition form therewith a complete wall extending between and completely separating the confronting ends of the walls 78 and 80. The expansion joint gas seals are separate and are located on opposite sides of the partition. With this arrangement of elements, gas leaks direct from the up-pass 20 to the lower pressure down-pass 24 are prevented. In the event that a leak occurs the gas movement will be from the atmosphere into the furnace and the wall parts will not be subject to the destructive action of high temperature gases.

Fig. 5 of the drawings illustrates the manner in which the vertical section of the partition is associated with the separate casing sections. It is similar to disclosure of Fig. 4 and will be readily understood to be a continuation of the Fig. 4 structure. The wall 93 is in a somewhat lower temperature gas zone than the wall 80, and hence is not as thick.

Fig. 4 illustrates the junction of the vertical buckstays 110 and 112 with the inclined buckstays 70 and 76. These parts, as well as the expansion joint parts between them, are shown as being mitered so as to form a single straight line joint, but it is to be understood that separate mitered sections of these parts might be added to the joint so as to make it a two-line joint. In this latter event the juncture of the buckstays and their attached parts would approach the curvature of the seal tube 34 which is shown as having a gradual curvature at the juncture of the vertical and inclined portions of the partition 32.

The partition cooling tubes 34 are connected into the boiler circulation as indicated in Fig. 2. They are directly connected at their lower end to the downtake headers 114. The upper end of all of the tubes 34 are connected to a header 118 which is located at the top of the partition. This header is connected to the steam space of the drum 120 by circulators 122. The drum and the circulators are shown suspended from the framework 124 by loops 126 and rods 128.

In the up-pass and the down-pass separated by the partition tubes 34 banks of fluid heat exchange tubes are shown. The cooler gases in the down-pass contact with the tubes of the economizer 130. These tubes are connected to an inlet header which receives feed water from any convenient source. At their other ends they are connected to the water space of the drum 120 through the intermediacy of the outlet header 134.

In the up-pass there are located two fluid heaters 136 and 138. These heaters may be superheaters connected in series or in parallel, or one of them may be a reheater. The tubes of these heaters are shown extending through the exterior wall 140 of the up-pass 20 to inlet headers 142 and 144 on one side, and to outlet headers 146 and 148 on the other side. All of these headers are preferably in vertical alignment and are supported by the saturated steam tubes 150 and 152 arranged in rows on opposite sides of the header. These tubes are shown to be supported by suspension rods 154 and 156 from the framework 124. They are connected at their lower ends to the header 142 and at their upper ends to the steam space of the drum 120.

The downtake headers 114 are connected to the water space of the drum 120 by downtake circu-

lators 158 as shown in Fig. 1 of the drawings. These circulators are preferably positioned in two spaced rows where they cross the outlet 26. With this arrangement there is no excessive flow resistance imposed upon the gases by the downtake circulators. Along their upper parts they support refractory material which forms the rearward wall 160 of the down-pass 24.

The downtake headers are connected to the uptake headers 192 by horizontally inclined steam generating tubes 193 which extend across the path of hot gases passing from the furnace 196. The latter is indicated as a slag tap furnace fired by burners 198 and 200 supplied with secondary air through the chamber 202. These burners preferably direct fuel streams between wall tubes 206 connected at their ends to headers 208 and 210. Similar wall tubes 209 join the headers 208 and 212 on one side of the furnace, and 214 and 216 on the other side of the furnace. The water tubes are preferably covered with refractory as are the floor tubes 218. When a slag pool collects in the furnace it may be tapped through the opening 220.

The headers 210 and 216 are connected into the boiler circulation by tubes 222 and 224 and there may be similar tubes connecting the lower headers with the drum 120. Similar connections 226 and 228 are provided for the headers 230 and 232 of a furnace screen formed by inclined tubes 234 connecting the headers 230 and 232.

The hot gases from the furnace pass through the flue or outlet 26 to a dust hopper 240 located at the base of the air heater 28. Any material collecting in this hopper may be withdrawn through the discharge tube 242.

Referring to Fig 3 of the drawings the partition 32 is shown between the front and rear walls 140 and 160. Beyond the wall 140 is an exterior casing having the panel wall 244, and a similar exterior casing wall 246 is shown spaced from the wall 160. Fig. 2 shows a side wall connecting the walls 244 and 246. It includes the buckstays 110 and 112 and other vertical members 248 and 250 of an outside insulating panel wall construction as well as the horizontals 252, 254 and 256.

In the structure indicated in Fig. 2 of the drawings the exterior wall is preferably of insulating panel construction and the wall sections A B C D E, and F G H H' I J K are unitarily suspended from the load carrying structure at the top of the installation. These sections thus expand downwardly, as do the pressure parts of the boiler. Along the line K H' H there is preferably located an expansion joint, permitting this expansion and the upward expansion of the panel wall section L M O P R which is preferably supported by the water tube side wall of the furnace.

I claim:

1. In combination, spaced casing sections forming walls of adjoining gas passes, a partition forming a wall common to both gas passes, and independent means on opposite sides of the partition movably associating the partition with the sections and completing a gas pass structure on each side of the partition.

2. In a wall construction, a plurality of casing sections each forming walls of two adjacent chambers, a partition disposed between the sections and constituting a wall common to both chambers, and means on opposite sides of the partition independently associating each section with the partition so as to permit the partition to move independently relative to each section.

3. In a multiple gas pass steam boiler, a partition common to two gas passes, a slotted casing having the partition extending through the slot and separating two parts of the casing, and independent means on opposite sides of the partition independently joining the two casing parts with the partition so as to complete two gas pass structures and allow the partition to move independently of either casing part.

4. In combination, a boiler casing divided at one end into separate sections, an imperforate wall interposed relative to the sections and separating two gas passes, and independent expansion joint and gas seal structures on opposite sides of the wall permitting the wall to move relative to and independently of each section, each of said structures operatively connecting the wall and one of said sections to maintain a separate gas pass.

5. In fluid heat exchange apparatus, adjacent casings forming the walls of two separate fluid passes, means causing fluid to flow in the same stream through the passes so that the temperature and pressure of the fluid in one pass are higher than in the other, a wall common to both passes and the casings, and independent gas seal and expansion joint structures on opposite sides of the common wall preventing fluid leakage from one pass to the other while permitting the common wall to have movement relative to each casing independently.

6. In combination, a furnace, a bank of inclined steam generating tubes contacted by gases passing from the furnace, a fluid cooled partition dividing the space above the generating tubes into two of serially connected gas passes, having an outlet adjacent the inlet ends of the generating tubes, induced draft means beyond the outlet operating to create sub-atmospheric pressures in the passes, fluid heat exchange tubes positioned in the passes and cooperating with said means to cause pressure on the outlet side of the lower end of the partition lower than the pressure on the opposite side, a casing having spaced sections on opposite sides of the partition, and independent expansion joint and gas seal structures on opposite sides of the partition and joining the latter and the spaced sections.

7. A fluid heat exchange apparatus comprising, in combination, a bank of fluid heat exchange tubes exposed to contact with furnace gases in the high pressure part of a gas pass, a primary casing enclosing at least parts of the tubes and forming a wall of the gas pass, a secondary casing forming a continuation or low pressure part of the same gas pass, said casings having an intermediate wall common to both gas pass parts, means for creating an induced draft so that there will be a higher pressure in the first mentioned part of the gas pass, extensions of the intermediate wall projecting outwardly of the inner surfaces of opposite sides of the casing, independent gas seal structures movably relating the casings and said extensions, the arrangement of the extensions and the joints being such that if any leakage of furnace gases occurs it must be from the atmosphere into one casing and not from one casing to the other.

8. In a high head boiler, a boiler setting, a steam and water drum, a bank of steam generating tubes positioned at a substantial distance below the drum, an upright water cooled wall extending upwardly from the steam generating tubes at a position intermediate their lengths and dividing the gas space above the tubes into

an up-pass and a down-pass, a flue for furnace gases at the lower end of the down-pass, a primary casing cooperating with said wall to form the up-pass, a secondary casing cooperating with the other side of the wall to form the down-pass, a gas seal movably joining the primary casing with one side of said wall, and another gas seal structure movably joining the second casing with the other side of said wall.

9. In a high head boiler having inclined steam generating tubes, an intermediate wall positioned above the tubes and separating an up-pass from a down-pass, a source of heating gases, an outlet for heating gases at the base of the down-pass, fluid heat exchange tubes in said passes, a primary casing forming boundaries of the up-pass, a secondary casing forming boundaries of the down-pass, a gas seal and expansion joint structure joining the primary section with one side of said wall, and an independently operating gas seal and expansion joint structure connecting the other side of said wall and the secondary casing, the arrangement of said structures being such that the wall may move independently of the casings while permitting a fluid pressure to be maintained at the bottom of the up-pass higher than a pressure at the bottom of the down-pass.

10. In a high head boiler, a bank of inclined steam generating tubes extending across the path of furnace gases, a downtake header construction at the lower end of the tubes, an uptake header construction at the opposite ends of the tubes, a steam and water drum above the bank of tubes, downtake tubes leading downwardly from the water space of the drum to the downtake header construction, uptake tubes connecting the uptake header construction with the steam space of the drum, partition supporting tubes connected at their lower ends to the downtake header construction and having upright parts positioned in a row between said uptake and downtake tubes and connected to said drum, refractory material closing the spaces between the partition tubes and constituting therewith a partition separating two upright and serially connected gas passes, gas pass walls along the uptake and downtake tubes, and pairs of separated opposite casing walls connected to the partition and the gas pass walls to complete the gas passes, the casing walls being divided so as to straddle the partition wall.

11. In combination, a furnace, a bank of inclined steam generating tubes contacted by gases passing from the furnace, a fluid cooled partition dividing the space above the generating tubes into two serially connected gas passes having an outlet adjacent the inlet ends of the generating tubes, induced draft means beyond the outlet operating to create sub-atmospheric pressures in the passes, fluid heat exchange tubes positioned in the passes and cooperating with said means to cause the pressure on the outlet side of the lower end of the partition to be lower than the pressure on the opposite side, a casing having spaced sections on opposite sides of the partition, and independent expansion joint and gas seal structures on opposite sides of the partition and joining the latter and the spaced sections.

12. A fluid heat exchange apparatus comprising, in combination, a bank of fluid heat exchange tubes exposed to contact with furnace gases in the high pressure part of a gas pass, a primary casing enclosing at least parts of the tubes and forming a wall of the gas pass, a secondary casing forming a continuation or low pressure part of the same gas pass, said casings having an intermediate wall common to both parts of the gas pass, means for creating an induced draft in the gas pass so that there will be a higher pressure in the first mentioned part of the gas pass, extensions of the intermediate wall projecting beyond adjacent surfaces of the casings, independent gas seal structures movably relating the casings and said extensions, the arrangement of the extensions and the joints being such that if any leakage of furnace gases occurs it must be from the atmosphere into one casing and not from one casing to the other.

13. In a high head boiler, a boiler setting, a steam and water drum, a bank of steam generating tubes positioned at a substantial distance below the drum, an upright water cooled wall extending upwardly from the steam generating tubes at a position intermediate their lengths and dividing the gas space above the tubes into an up-pass and a down-pass, a flue for furnace gases at the lower end of the down-pass, a primary casing cooperating with said wall to form the up-pass, a secondary casing cooperating with the other side of the wall to form the down-pass, a gas seal movably joining the primary casing with one side of said wall, and another gas seal structure movably joining the second casing with the other side of said wall.

14. In a high head boiler having inclined steam generating tubes, an intermediate wall positioned above the tubes and separating an up-pass from a down-pass, a source of heating gases, an outlet for heating gases at the base of the down-pass, fluid heat exchange tubes in said passes, a primary casing forming boundaries of the up-pass, a secondary casing forming boundaries of the down-pass, a gas seal and expansion joint structure joining the primary section with one side of said wall, and an independently operating gas seal and expansion joint structure connecting the other side of said wall and the secondary casing, the arrangement of said structures being such that the wall may move independently of the casings while permitting a fluid pressure to be maintained at the bottom of the up-pass higher than the pressure at the bottom of the down-pass.

15. In a high head boiler, a bank of inclined steam generating tubes extending across the path of furnace gases, a downtake header construction at the lower end of the tubes, an uptake header construction at the opposite ends of the tubes, a steam and water drum above the bank of tubes, downtake tubes leading downwardly from the water space of the drum to the downtake header construction, uptake tubes connecting the uptake header construction with the steam space of the drum, partition supporting tubes connected at their lower ends to the downtake header construction and having upright parts positioned in a row between said uptake and downtake tubes and connected to said drum, refractory material closing the spaces between the partition tubes and constituting therewith a partition separating two upright and serially connected gas passes, gas pass walls along the uptake and downtake tubes, and separated opposite casing walls connected to the partition and the gas pass walls to complete the gas passes, the casing walls being divided so as to straddle the partition wall.

16. In fluid heat exchange apparatus having

adjoining gas passes, a wall construction common to said passes, means for creating different fluid pressures in said passes, separate casings including wall sections arranged on opposite sides of the common wall, and separate fluid seal structures arranged on opposite sides of the common wall for independently associating said sections with opposite sides of the common wall.

17. In fluid heat exchange apparatus having adjoining gas passes, a wall construction common to said passes, means for creating different temperature conditions in said passes, separate casings including wall sections arranged on opposite sides of the common wall and adjacent thereto, and separate fluid seal structures arranged on opposite sides of the common wall for independently movably associating said sections with opposite sides of the common wall.

18. In apparatus subjected to the heat of furnace gases, two wall sections for adjoining furnace gas chambers, a wall common to said chambers and arranged between said sections, and separate expansion joint gas seal structures on opposite sides of the common wall permitting relative movements of said wall and wall sections while preventing any gas leakage past said wall from one chamber to the other.

19. In fluid heat exchange apparatus; a baffle, side walls co-operating with one side of the baffle to define a first gas pass on one side of the baffle, other side walls co-operating with the opposite side of the baffle to define a second gas pass, means associating the side walls of the first gas pass with the baffle to maintain a fluid tight casing while permitting a certain degree of relative movement between the baffle and the first mentioned side walls, other means associating the side walls of the second gas pass with the baffle to maintain a fluid tight casing while permitting another degree of relative movement between those side walls and the baffle, tubes forming parts of the baffle, means connecting the tubes into a fluid circulation system; said first mentioned means including metallic members secured in good heat exchange relationship with some of the said tubes and presenting flat surfaces along which said relative movements take place, a first set of co-operating metallic members carried by the first gas pass side walls, and a second set of metallic members secured to the second gas pass side walls, the first and second sets of metallic members slidingly engaging the first mentioned metallic members.

20. In apparatus of the class described, a baffle, walls cooperating with the baffle to define gas passes on opposite sides of the baffle, means associating said walls with the baffle to maintain fluid tight casings while permitting a certain degree of relative movement between the baffle and the walls, tubes forming a part of the baffle and constituting parts of a fluid circulation system; said means including metallic members secured in good heat exchange relationship with some of the said tubes and presenting surfaces along which said relative movements take place, and sets of cooperating metallic members carried by the walls and cooperating with the first mentioned metallic members to provide seals between the gas pass walls and the baffle.

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